

# The World Wide Web

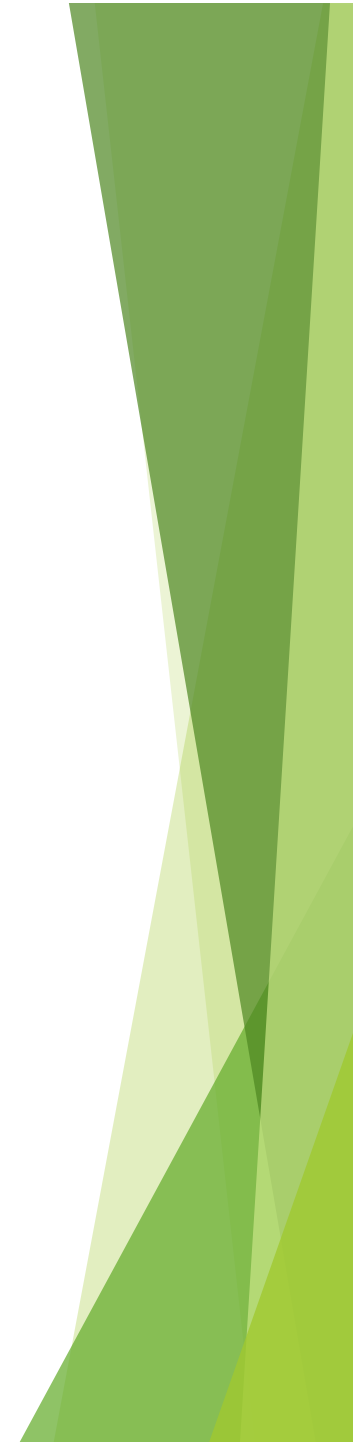
Lecture 7 - COMPSCI111/111G



*"On the Internet, nobody knows you're a dog."*

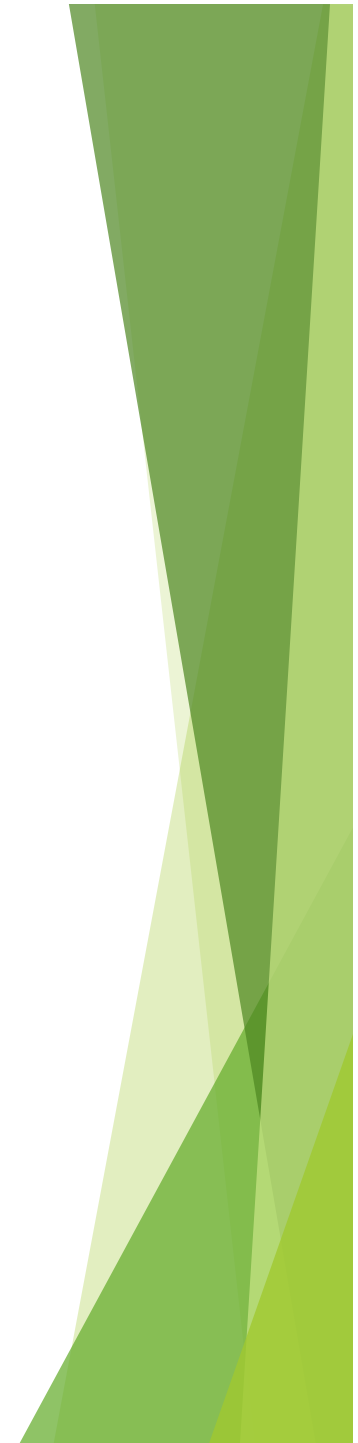
# Today's lecture

- ▶ Recap material on the Internet and World Wide Web (WWW)
- ▶ Understand how the WWW works
- ▶ Understand how search engines work
- ▶ The implications of search engines



# Recap

- ▶ Previously, we saw:
  - ▶ WWW refers to the applications (eg. web pages, email, Skype, Youtube etc) that run on the Internet, which refers to the underlying hardware
  - ▶ The Internet includes the hardware and protocols that transport data from sender to receiver
- ▶ We've already looked at a few WWW applications (eg. email, blogs, instant messaging)



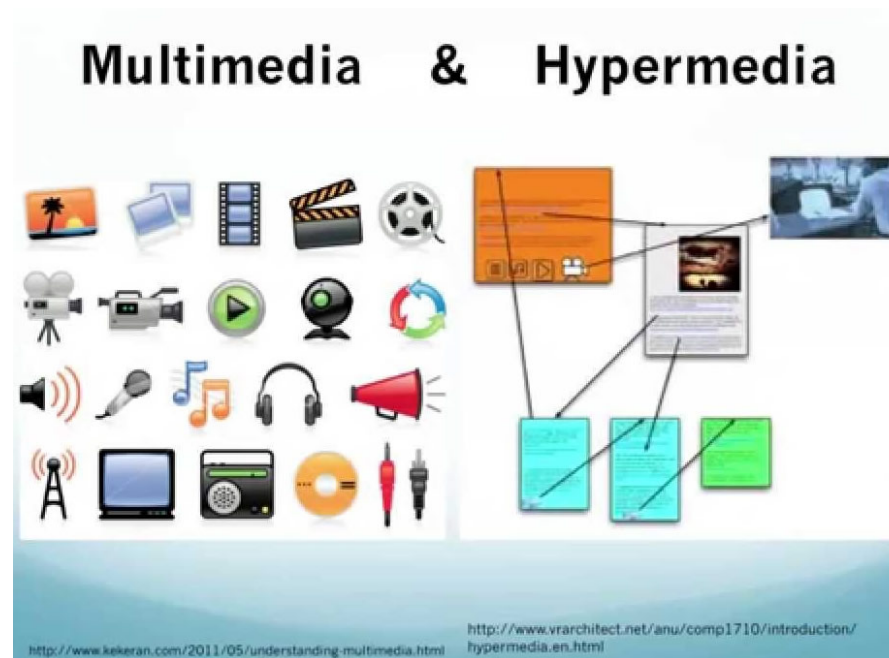
# Hypertext

- ▶ Hypertext is basically text with links
  - ▶ Allows associations to be made between pieces of text
- ▶ Vannevar Bush - “*As We May Think*” (1945)
  - ▶ Bush described a device called a **memex**, which could store text and links within the text
- ▶ Ted Nelson - the Xanadu Project (1960s)
  - ▶ First computer-based hypertext implementation
  - ▶ Although developed in the 1960s, the first public release was in 1998



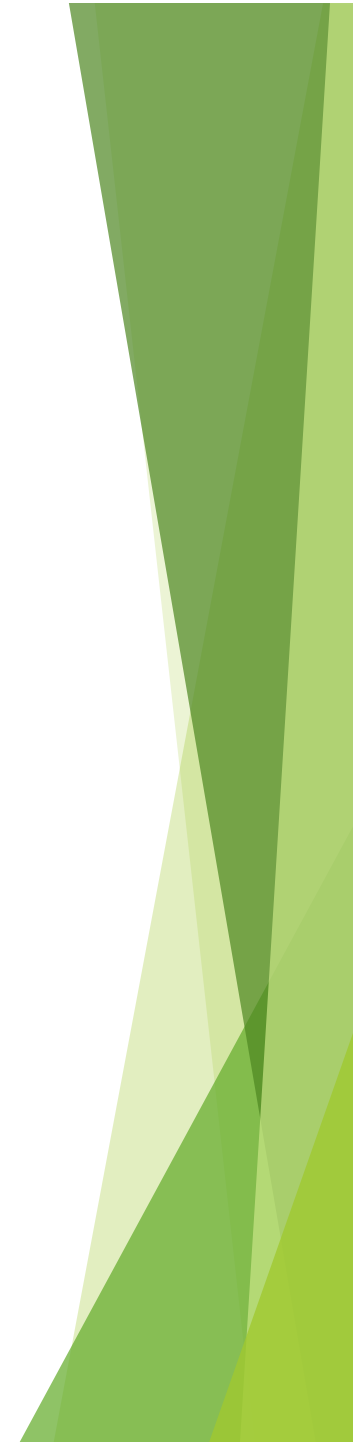
# Multimedia and hypermedia

- ▶ Multimedia: the integration of many forms of media (text, video, sound, images etc)
- ▶ Hypermedia: the creation of links between multimedia content



# The WWW project

- ▶ Tim Berners-Lee worked at CERN in the 1980s
- ▶ Physicists performing research at CERN found it difficult to share their research with each other
- ▶ Berners-Lee thought he could solve this problem using hypertext and wrote “*Information Management: A Proposal*” outlining his idea in 1989
  - ▶ He envisioned a linked information system where pages could be added and accessed by CERN employees
  - ▶ Pages would be stored on a server



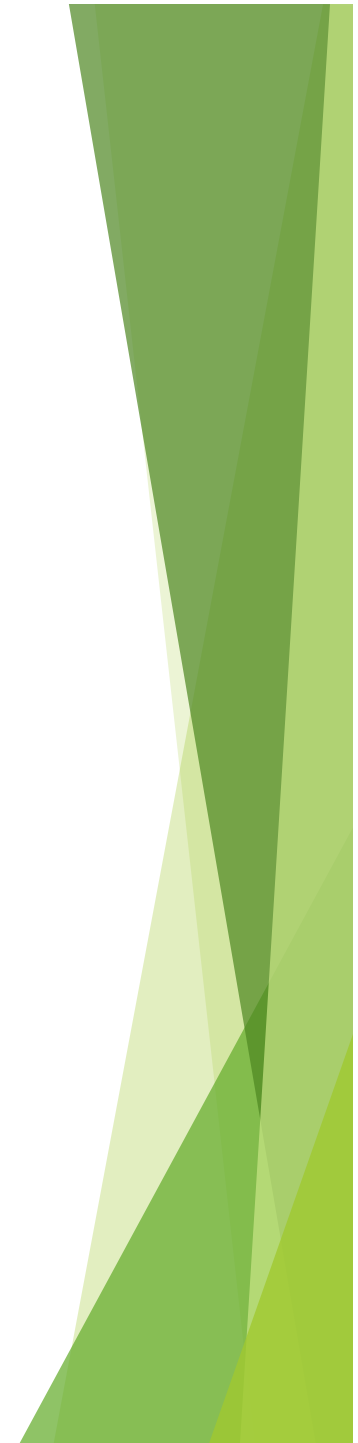
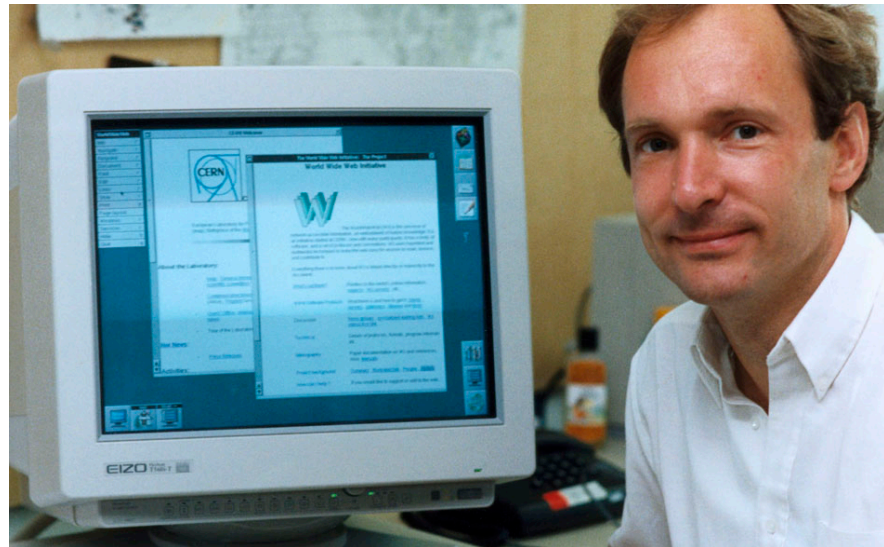
# The WWW project

- ▶ After development in CERN, the first public web server was set up in 1991
- ▶ In June 1993, Mosaic was released; the first widely used web browser
- ▶ By Oct 1993, there were 500 web servers around the world
  - ▶ By this point, Berners-Lee realised the WWW had to be freely available so he convinced CERN to make the source code public



# The WWW project

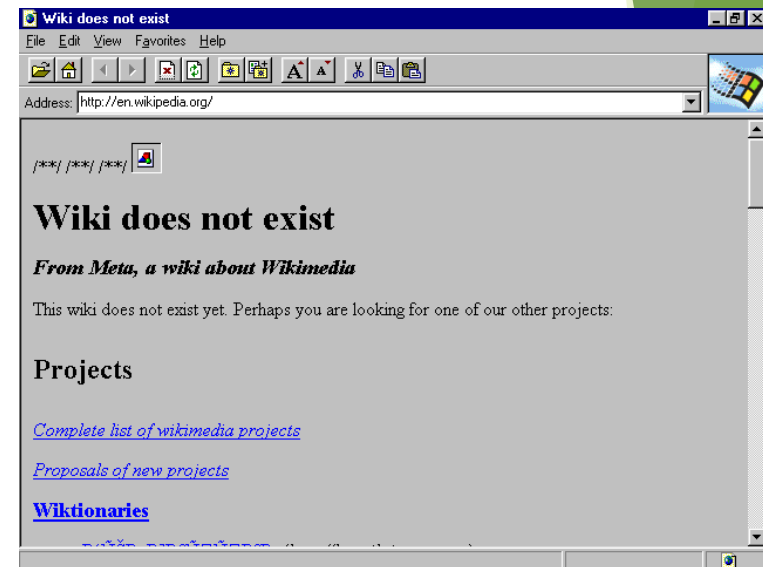
- ▶ In 1994, Berners-Lee established the World Wide Web Consortium (W3C), which creates standards for the WWW





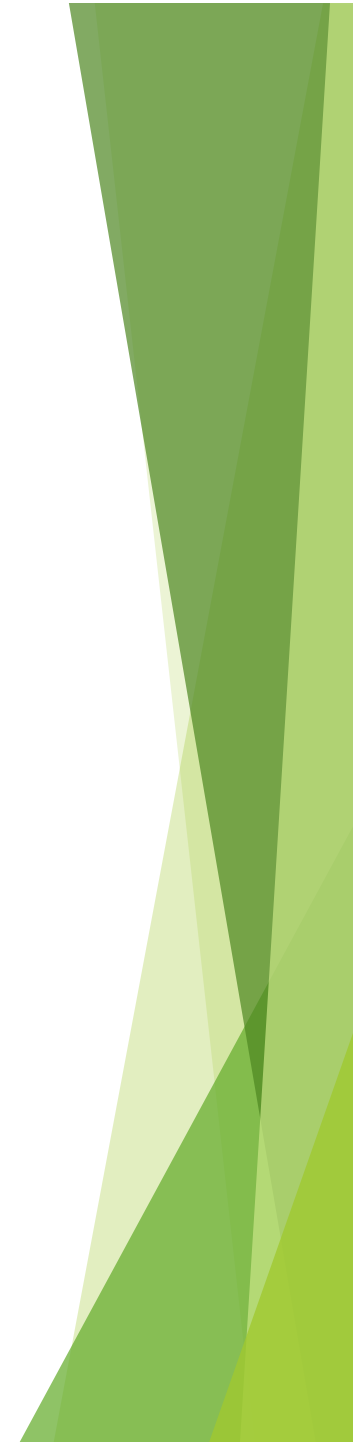
# Evolution of the Web

- ▶ 1994: Netscape Communications and Yahoo! founded
- ▶ 1995: first version of Microsoft Internet Explorer released
- ▶ 1998: Google founded
- ▶ 1997-2001: “Dot-com” boom and bust
- ▶ 2004: shift to ‘Web 2.0’ (eg. wikis)



# Some terms

- ▶ **Webpage:** a hypermedia document on the WWW that is usually accessed through a web browser
- ▶ **Website:** a collection of webpages usually on the same topic or theme
- ▶ **Web browser:** application software used to access content on the WWW
- ▶ **Web server:** a computer with software that makes files available on the WWW

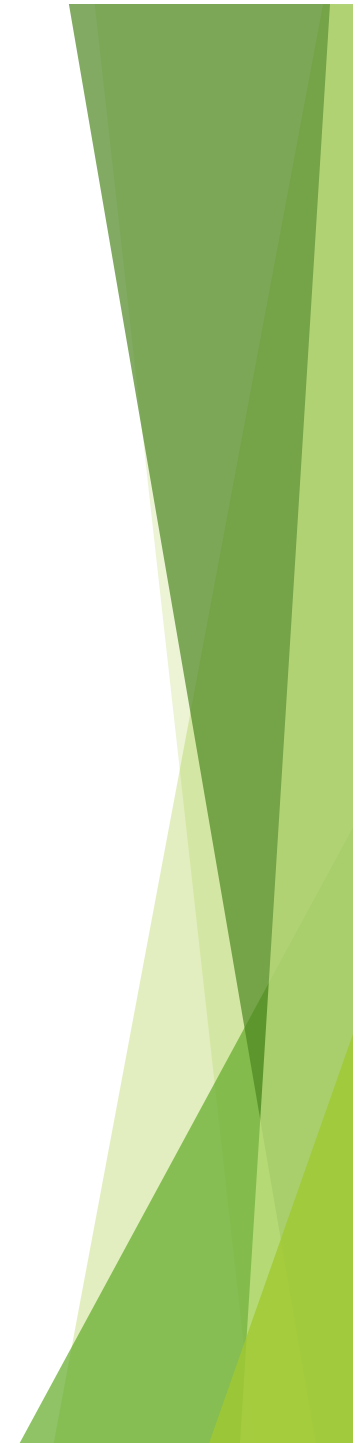


# Uniform Resource Locator (URL)

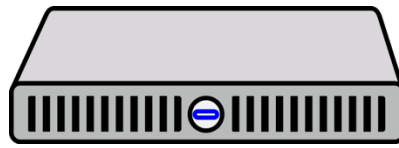
- ▶ **`https://www.cs.auckland.ac.nz/~andrew/teaching.html`**
- ▶ Protocol: `https`
  - ▶ Other common protocols: `ftp`, `http`
- ▶ Domain: `www.cs.auckland.ac.nz`
  - ▶ Can be a domain name or an IP address
- ▶ Path on server: `/~andrew/`
- ▶ Resource: `teaching.html`

# HTTP

- ▶ HyperText Transfer Protocol; used by web browsers to request resources (eg. webpages, images, sounds) from a web server
- ▶ There's also HTTPS = HyperText Transfer Protocol Secure
  - ▶ Encrypts the HTTP connection using TLS (Transport Layer Security)
  - ▶ Becoming essential for websites to use HTTPS to keep user information secure



Find IP address of  
www.google.com



**DNS  
SERVER**



**CLIENT**

**GET /index.html HTTP/1.1**

**HTTP/1.1 200 OK**

**GET /img/logo.jpg HTTP/1.1**

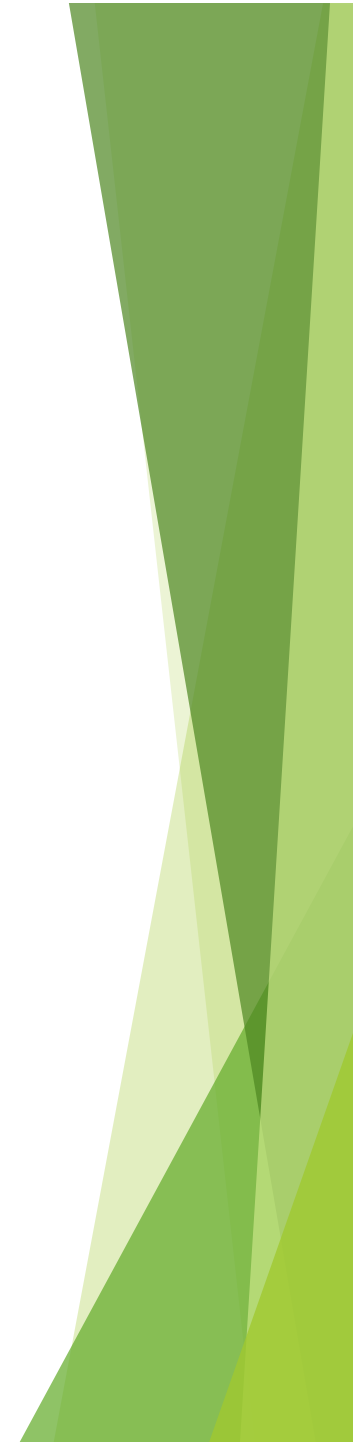
**HTTP/1.1 404 NOT FOUND**



**SERVER**

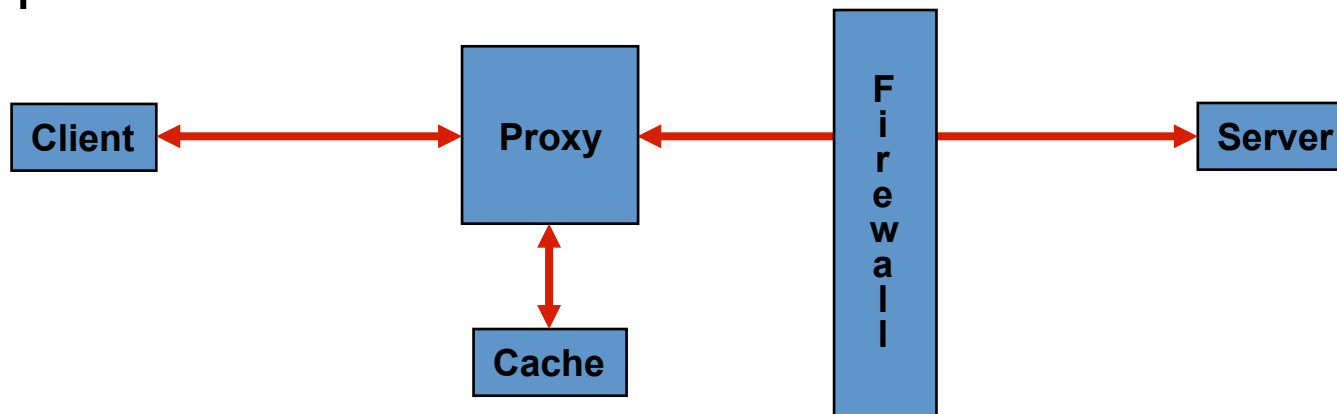
# Logging browsing history

- ▶ A number of computers keep a record of the webpages accessed by a client:
  - ▶ Web browser
  - ▶ Computer's operating system
  - ▶ ISPs
    - ▶ They hold varying amounts of information
    - ▶ In Australia, ISPs must retain information about their customers' web usage for at least 2 years
  - ▶ The web server



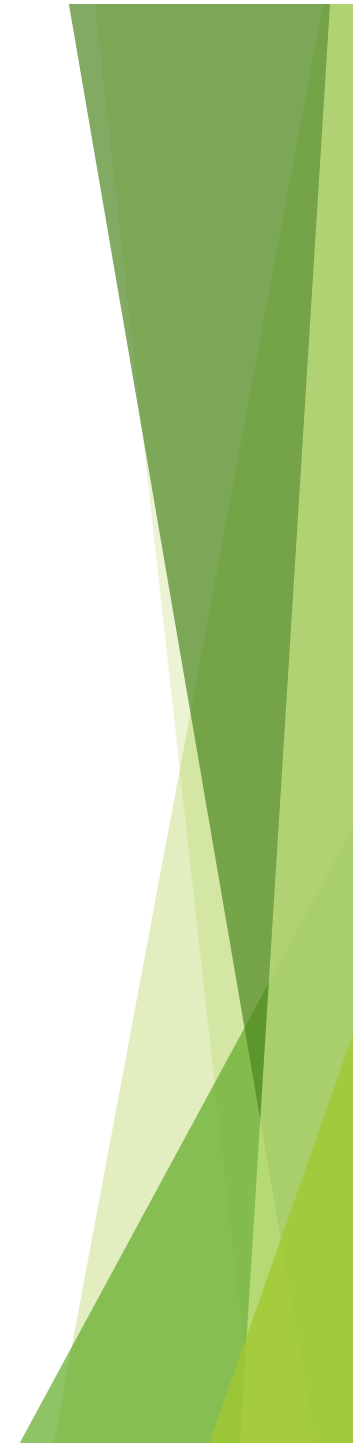
# Other parts of the WWW

- ▶ **Proxy:** sits between client and server so it can intercept and process requests
- ▶ **Cache:** stores recently requested resources so they can be accessed quickly
  - ▶ A proxy can use a cache to store recent requests, enabling it to process requests faster
- ▶ **Firewall:** prevents unauthorised access to a private network



# Problems with webpages

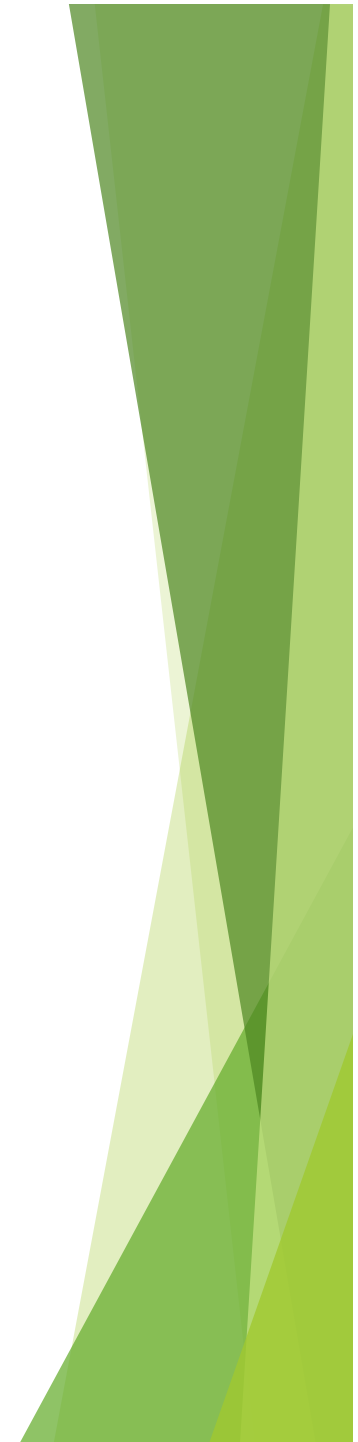
- ▶ Broken links
  - ▶ Usually the result of a webpage being moved or deleted
- ▶ No inherent security/tracking/accounting system
  - ▶ Difficult to have layers of security and a consistent level of security
  - ▶ Websites rely heavily on ad revenues
- ▶ No inherent way of indexing information
  - ▶ Difficult to find information on the web, although search engines help
  - ▶ Dynamically generated webpages and different file formats (eg. PDF, archives) also make indexing difficult



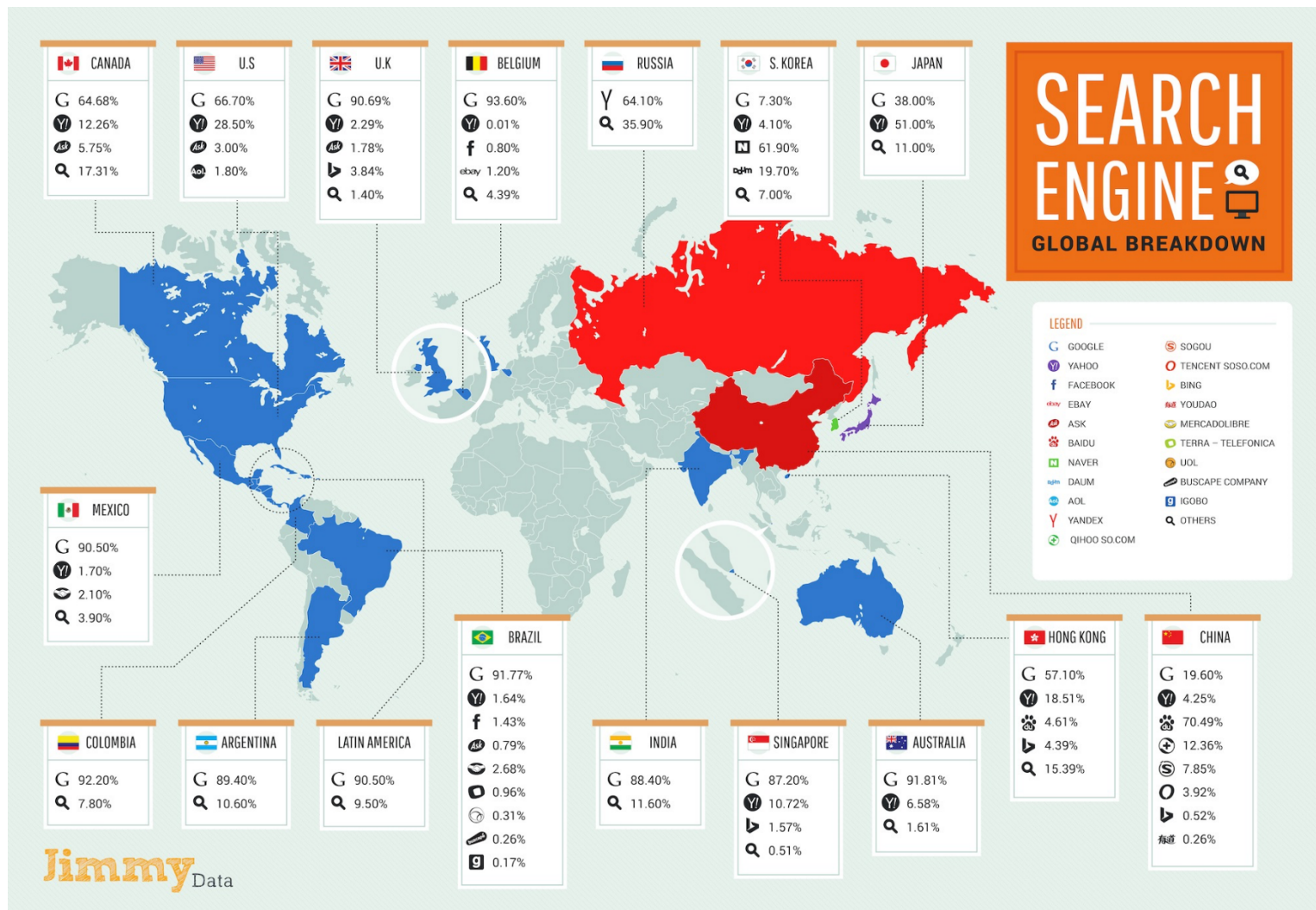


# Search engines

- ▶ A website that helps a user to search for information on the WWW
- ▶ Software indexes content on the web. This index is used to build a list of results based on the search terms entered by the users
  - ▶ **Indexing:** organising data so that it is easier to search
- ▶ Popular search engines include:
  - ▶ Google
  - ▶ Bing
  - ▶ Yahoo search
  - ▶ DuckDuckGo

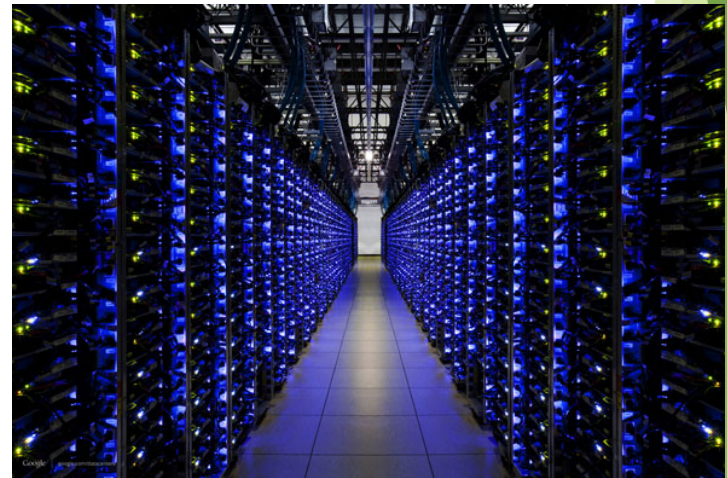
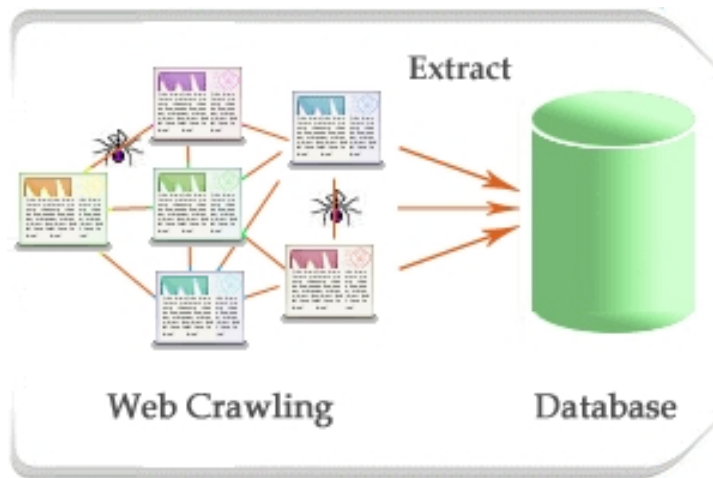


# Search engines



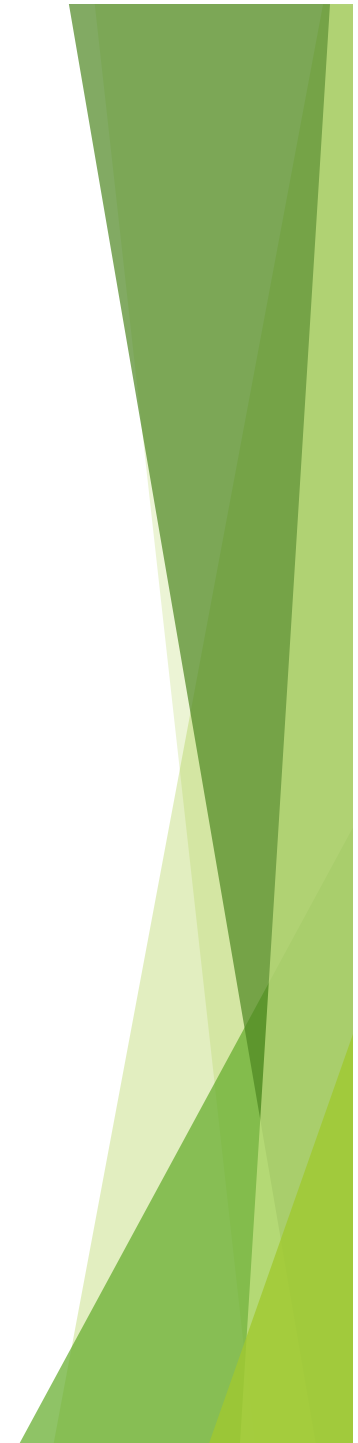
# How do search engines work?

- ▶ Spiders crawl across the WWW to scan webpages
  - ▶ Spiders are programs that follow links and gather information from webpages
- ▶ The search engine's index is updated with information gathered by the spiders



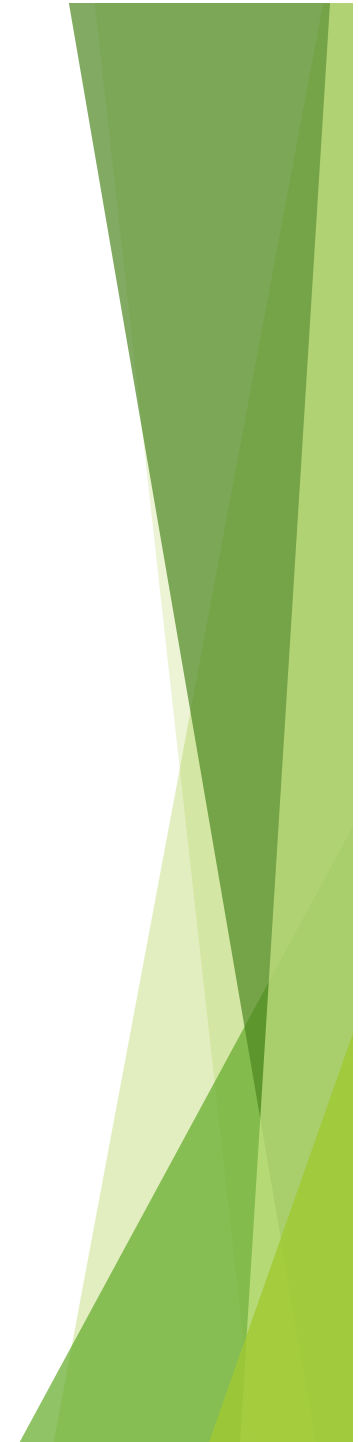
# How do search engines work?

- ▶ User enters a search term
- ▶ The search engine uses algorithms to find the most relevant results in its index
  - ▶ These algorithms are secret and highly complex
  - ▶ They use a number of criteria, such as keywords and popularity, to determine a page's relevance to the user
- ▶ Search engine gives the user a list of results
  - ▶ This list is compiled from billions of webpages in a couple of seconds!



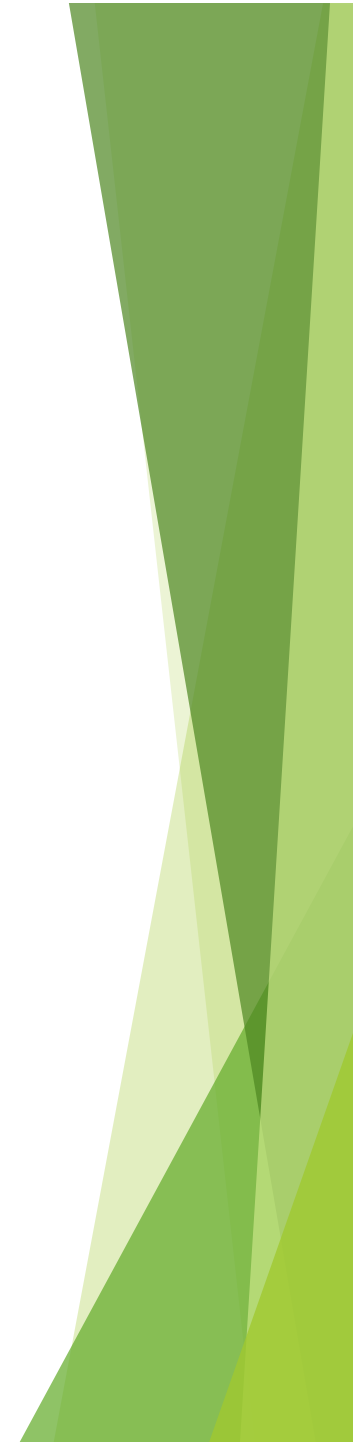
# Can we trust search engines?

- ▶ Bias in the results?
  - ▶ Since search algorithms are secret, we have to trust that they operating fairly
  - ▶ Effect of filtering on search results (eg. [DMCA](#), images of child abuse)
- ▶ Advertising plays a big role in how search engines operate
  - ▶ Search engines make money from advertising
  - ▶ Companies misuse search engines to get a competitive edge: NakedBus using ‘inter city’ on Google Adwords (a good summary can be found [here](#))



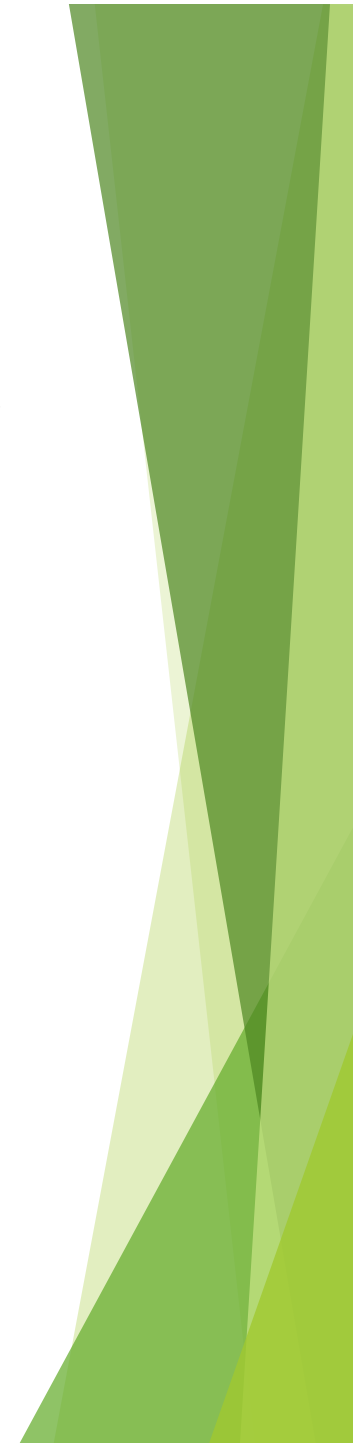
# Can we trust search engines?

- ▶ The right to be forgotten (R2BF)
  - ▶ In 2014, European Court of Justice decided R2BF meant Google has to remove out-of-date search results when requested by individuals
    - ▶ A good summary can be found [here](#)
  - ▶ In Europe, the General Data Protection Regulation 2016 contains a more limited '[right to erasure](#)'
- ▶ R2BF helps an individual to preserve their privacy
- ▶ However, the R2BF distorts search results and could be abused (eg. a businessman wanting news articles removed from search results)



# Filter bubble

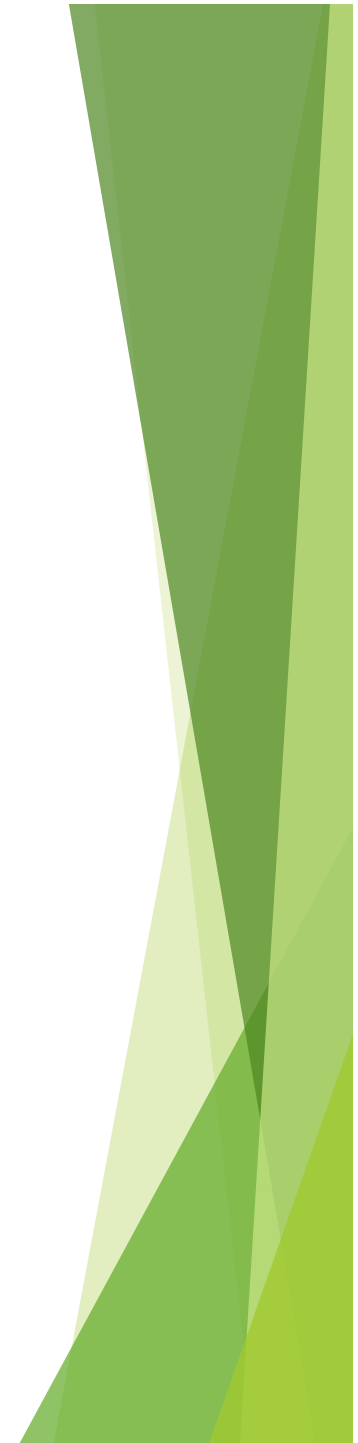
- ▶ Occurs when a search algorithm offers personalised results, which limits the diversity of information presented to the user
  - ▶ Examples include Facebook's News Feed and Google's personalised search results
- ▶ Personalised search results can help people to find relevant information
- ▶ However, it also risks isolating people within their own bubble of information





# Privacy

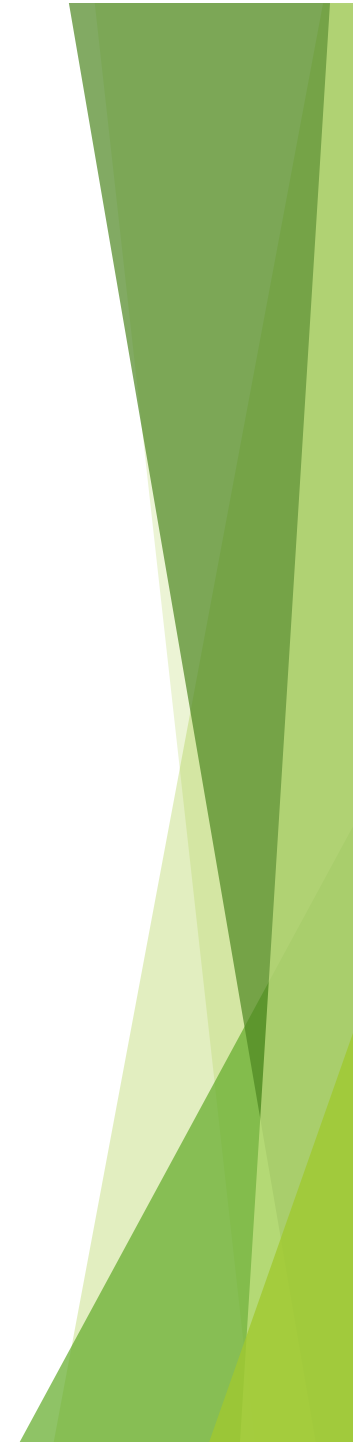
- ▶ Search engines are gathering vast amounts of information about our searches and ourselves
  - ▶ This information is generally used for advertising purposes
- ▶ Can we trust private companies to treat our information with care? To keep it secure? To not sell it to others without consent?
- ▶ While you can search anonymously, search history can be used to identify individuals
  - ▶ A reporter used a person's anonymised search history to track them down - article [here](#)





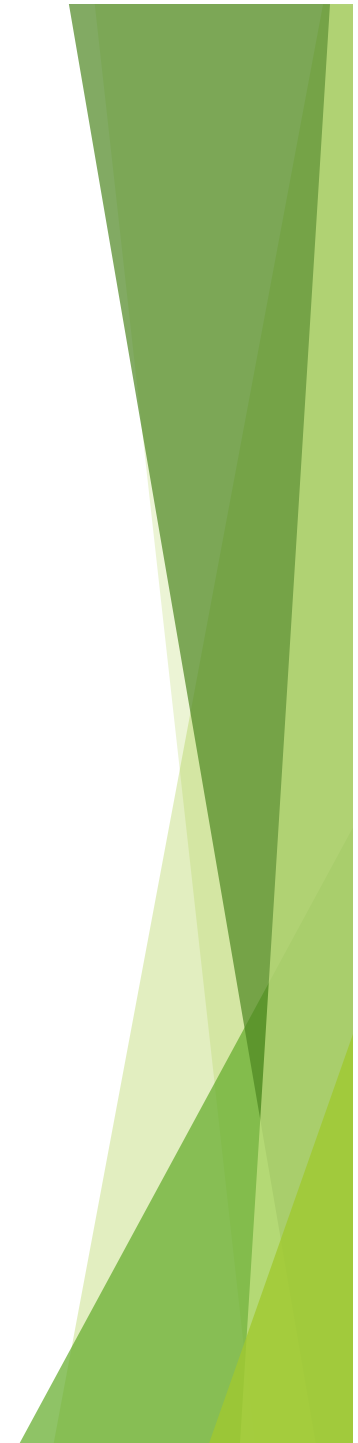
# Questions

- ▶ What problem did Tim Berners-Lee want to solve using the Web?
- ▶ What is the difference between a firewall and proxy?
- ▶ Name two ways that bias could be introduced into search results



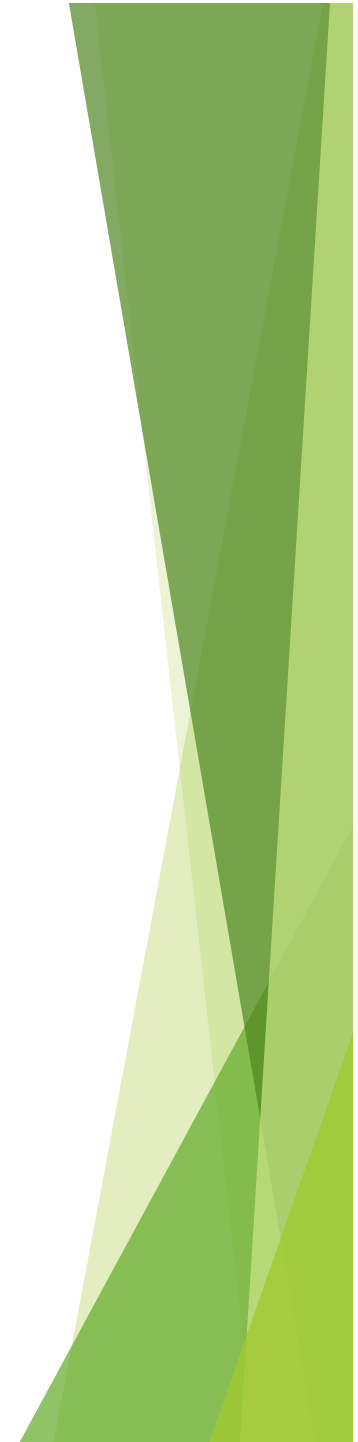
# Answers

- ▶ What problem did Tim Berners-Lee think he could solve using the Web?
  - ▶ Sharing information between researchers at CERN
- ▶ What is the difference between a firewall and proxy?
  - ▶ Firewall: prevents unauthorised access to a network
  - ▶ Proxy: intercepts and processes requests from clients and servers
- ▶ Name two ways that bias could be introduced into search results
  - ▶ Any of: DMCA requests, filtering illegal content, filter bubbles, right to be forgotten



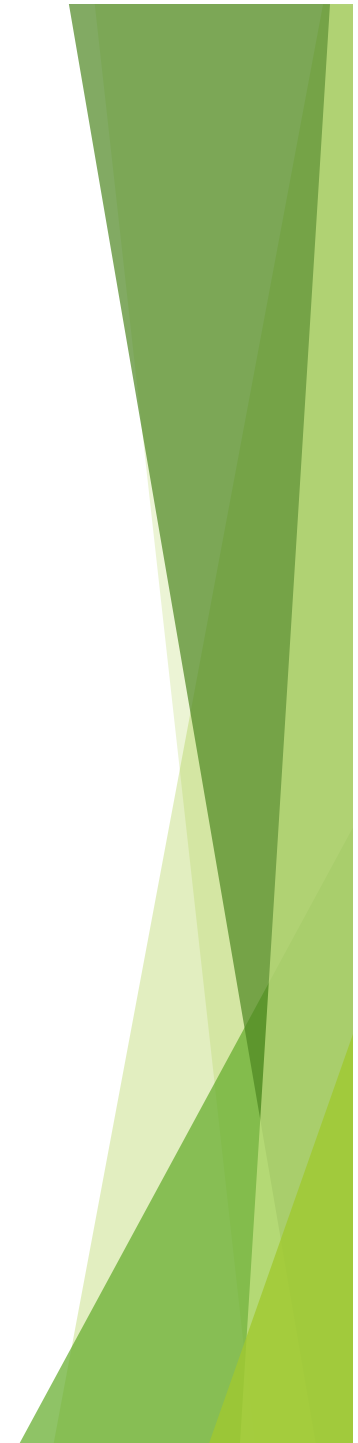
# Summary

- ▶ The WWW was designed to be a system to share information
  - ▶ It has become a system for creating and sharing a variety of content
  - ▶ Key protocol on the WWW is HTTP
- ▶ Search engines use an index of the WWW to provide results based on search terms
- ▶ Issues around search engines
  - ▶ Bias
  - ▶ Protecting privacy (eg. R2BF)
  - ▶ Use of personal information for advertising
  - ▶ Filter bubbles



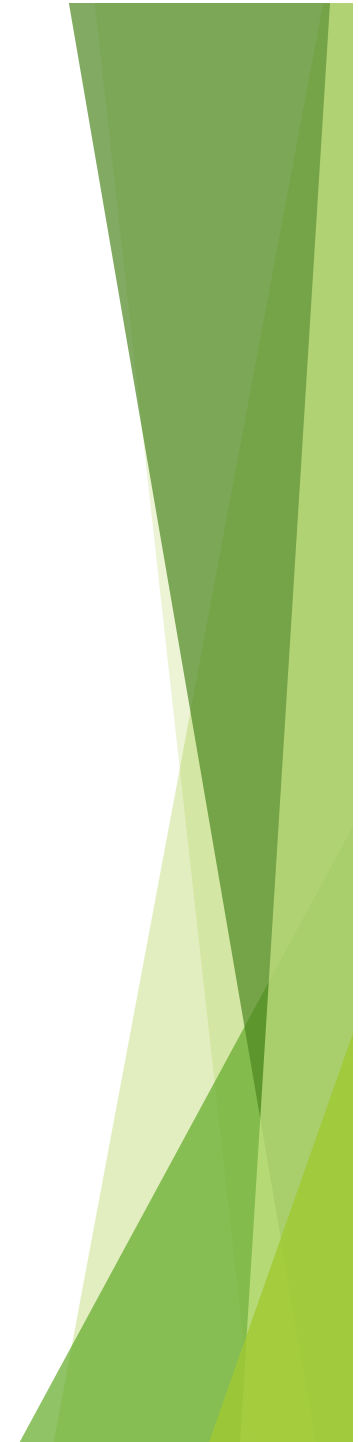
## Which of the following statements is FALSE?

- ▶ Google search results return the same information to anyone who enters the same keywords.
- ▶ Personalised search results can help people to find relevant information.
- ▶ Search engines are gathering vast amounts of information.
- ▶ A filter bubble risks isolating people within their own bubble of information.
- ▶ Search history can be used to identify individuals, even when searching anonymously.



# Which of the following statements is FALSE?

- ▶ Google search results return the same information to anyone who enters the same keywords.
- ▶ Personalised search results can help people to find relevant information.
- ▶ Search engines are gathering vast amounts of information.
- ▶ A filter bubble risks isolating people within their own bubble of information.
- ▶ Search history can be used to identify individuals, even when searching anonymously.

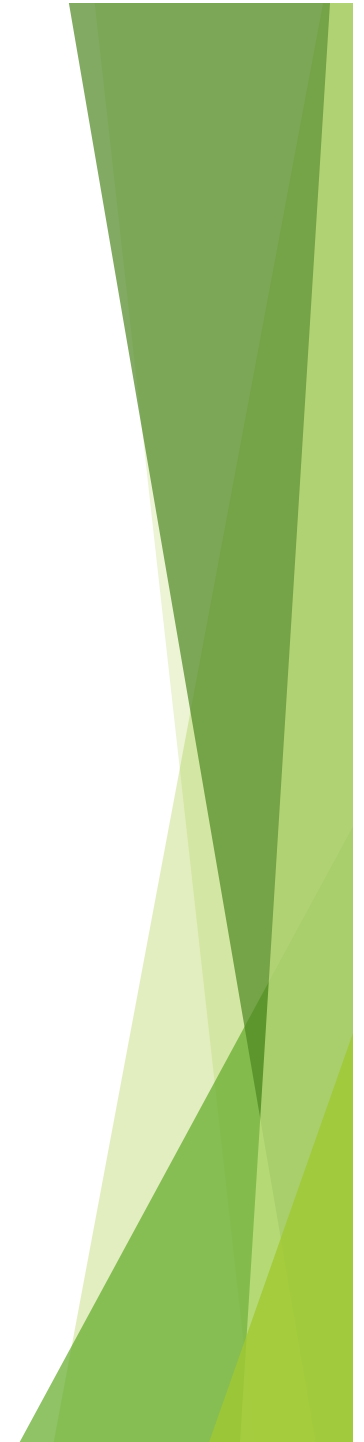


Given the URL:

<https://www.cs.auckland.ac.nz/~andrew/teaching.html>

which of the following statements is FALSE?

- ▶ teaching.html is the resource
- ▶ ~andrew is the path on the server
- ▶ [www.cs.auckland.ac.nz](https://www.cs.auckland.ac.nz) is the domain
- ▶ URL stands for Uniform Resource Locator
- ▶ https stands for hypertext transfer protocol standard



Given the URL:

<https://www.cs.auckland.ac.nz/~andrew/teaching.html>

which of the following statements is FALSE?

- ▶ teaching.html is the resource
- ▶ ~andrew is the path on the server
- ▶ [www.cs.auckland.ac.nz](http://www.cs.auckland.ac.nz) is the domain
- ▶ URL stands for Uniform Resource Locator
- ▶ **https** stands for **hypertext transfer protocol standard** - HyperText Transfer Protocol Secure

